MASTER OF SCIENCE
IN
APPLIED SCIENCE

"FOLLOW THE LEADER" TRACKING BY AUTONOMOUS UNDERWATER VEHICLES (AUVS) USING ACOUSTIC COMMUNICATIONS AND RANGING

Daniel P. Kucik-DoD Civilian
B.S., University of Florida, 1999
Master of Science in Applied Science (Robotics)-September 2003
Advisors: Don Brutzman, Modeling, Virtual Environments, and Simulation Institute
Anthony Healey, Department of Mechanical Engineering
Douglas P. Horner, Department of Information Science

With advances in computer and sensor technologies, autonomous underwater vehicles (AUVs) are now capable of reaching a level of independent action once thought impossible. Through the use of cooperative behaviors, it is possible to further increase their autonomy by allowing multiple operating AUVs to simultaneously coordinate their activities in order to improve the efficiency and effectiveness of the overall system.

This thesis research defines the algorithms and rules needed to perform "follow the leader" cooperative behaviors during AUV rendezvous. This is a low-level first step towards more sophisticated cooperative behaviors, such as swarming or new forms of obstacle/trap avoidance. The approach taken here differs from previous research in that it does not rely on beacons or locator sensors, but instead uses ranging and intention information shared between the vehicles using acoustic communications.

Several tools and algorithms are presented to support the future development of cooperative behaviors. In particular, a previously developed 3D virtual world simulator that utilizes dynamics-based vehicle models has been enhanced to support multiple simultaneously operating vehicles. Finally, a procedural algorithm is shown to correct the relative navigation errors between two vehicles through the use of vehicle-to-vehicle communications and ranging information obtained via acoustic modems.

KEYWORDS: Autonomous Underwater Vehicle, Cooperative Behaviors, Relative Navigation Error Correction, Follow-the-Leader

ALLOCATING AIR FORCE CAREER FIELD ACCESSION TARGETS: AN OPTIMIZATION BASED TOOL

Robert D. Sickorez-Second Lieutenant, United States Air Force
B.S., United States Air Force Academy, 2002
Master of Science in Applied Science (Operations Research)-September 2003
Advisor: David H. Olwell, Department of Operations Research
Second Reader: W. Matthew Carlyle, Department of Operations Research

The United States Air Force (USAF) officer accession sources annually produce three thousand non-rated line officers who must be classified into career fields. Under the current system, many career field accession goals are not met. This mismatch occurs primarily because of unreasonable targets set for the various commissioning sources. This thesis presents an optimization-based target allocation tool that mitigates the existing mismatch between long-term manpower needs and near-term accession source outputs. This Java-based application enables users to weight multiple objectives, set priorities for filling various career fields, solve for optimal targets, and then explore results, presented in the form of interactive tables and charts. Within a friendly graphical user interface, users determine practical targets with ease by interactively adjusting the optimality criteria and fill priorities and then reviewing the resulting classifications. These new targets will vastly improve the ability of the USAF to meet accession needs, exploit the unique skills of its officers, and satisfy officer preferences. This means that officer recruiting dollars will be better utilized as long-term manpower needs are better met. Additionally, job performance

and retention are likely to improve as more career fields are filled with highly qualified officers and officers are more frequently placed into their desired career fields.

KEYWORDS: Optimization, Officer Classification, Networks, Java